

CLAIMS

1. A perpendicular magnetic recording medium comprising at least
a nonmagnetic under layer,
5 a magnetic layer, and
a protective layer
stacked on a nonmagnetic substrate, wherein
said magnetic layer includes a ferromagnetic crystal grain and a nonmagnetic
grain boundary region; and
10 said crystal grain boundary region comprises at least two kinds of oxide.
2. The perpendicular magnetic recording medium according to claim 1, wherein said
oxides which form said crystal grain boundary region includes at least two kinds of oxide
selected from those of Y oxides, W oxides, Mg oxides, Al oxides, Zr oxides, Hf oxides,
15 Ti oxides, Ce oxides, Si oxides, Cr oxides, Ni oxides, and Ta oxides.
3. The perpendicular magnetic recording medium according to claim 2, wherein said
oxides which form said crystal grain boundary region comprises:
at least one oxide selected from group A of Y oxides, W oxides, Mg oxides, Al
20 oxides, Zr oxides, and Hf oxides; and
at least one oxide selected from group B of Ti oxides, Ce oxides, Si oxides, Cr
oxides, Ni oxides, and Ta oxides.
4. The perpendicular magnetic recording medium according to claim 3, wherein the
25 oxide selected from said group A includes at least one oxide selected from Y oxides and

W oxides.

5. The perpendicular magnetic recording medium according to claim 3, wherein the oxide selected from said group B includes at least one oxide selected from Si oxides, Cr
5 oxides, and Ta oxides.

6. The perpendicular magnetic recording medium according to claim 3, wherein the content of the oxide selected from the group A in mole percentage is smaller than the content of the oxide selected from the group B in mole percentage in the oxides which
10 form said crystal grain boundary region.

7. The perpendicular magnetic recording medium according to claim 3, wherein oxygen concentration of the oxide selected from the group B is smaller than ratio of concentration calculated from the stoichiometric ratio in the oxides which form said
15 crystal grain boundary region.

8. The perpendicular magnetic recording medium according to claim 1, wherein oxygen concentration to all oxidizable elements in the crystal grain boundary region is smaller than the concentration of that calculated from the sum of the stoichiometric ratio
20 of all oxides.

9. The perpendicular magnetic recording medium according to claim 1, wherein the magnetic layer includes a total of 0.1 to 30 mol% of the oxides which form said crystal grain boundary region.

10. The perpendicular magnetic recording medium according to claim 1, wherein the magnetic layer includes a total of 1 to 20 mol% of the oxides which form said crystal grain boundary region.

5 11. The perpendicular magnetic recording medium according to claim 1, wherein a crystal grain included in said magnetic layer comprises CoPt alloy as a major component.

12. The perpendicular magnetic recording medium according to claim 1, wherein said nonmagnetic under layer comprises Ru as a major component.

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13. The perpendicular magnetic recording medium according to claim 1, which has at least one soft magnetic layer between said nonmagnetic substrate and said nonmagnetic under layer.

15 14. A magnetic recording/reproducing apparatus comprising;
the perpendicular magnetic recording medium according to claim 1,
a supporting and rotating driving mechanism of the perpendicular magnetic
recording medium,
a magnetic head having a device for recording information on said perpendicular
20 magnetic recording medium and a device for reproducing the recorded information, and
a carriage-assembly in which said magnetic head is supported freely movable
relative to said perpendicular magnetic recording medium.

15. A magnetic recording/reproducing apparatus according to claim 14, wherein said
25 read/write head is a single magnetic pole recording head.